

Hillcrest High School

PHYSICAL SCIENCE P2

Grade 12

June 2025 P2 memo

MARKS: 100
TIME: 2 Hours

EXAMINER: Mrs J. Knox-Whitehead
MODERATOR: Ms N. Badenhorst

- 1.1 B
- 1.2 B
- 1.3 A
- 1.4 D
- 1.5 B

When the Volume decreases the pressure increases, then the reaction that creates the least no of moles of GAS is favoured.

[10]

During hydrolysis the NH_4^+ that came from a weak base (NH_3 hydrolyses) and gives off $\text{H}^+/\text{H}_3\text{O}^+$

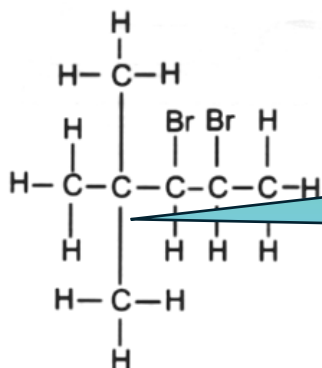
Question 2

2.1 A series of organic compounds that can be described by the same general formula / in which one member differs from the next with a CH₂ group. ✓✓ (2)

2.2.1 aldehyde ✓ (1)

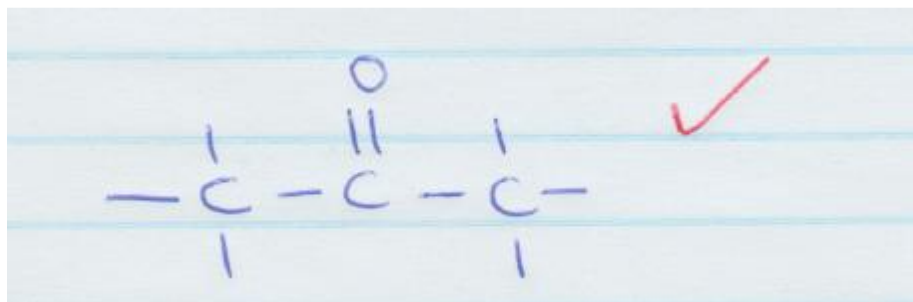
2.2.2 butan-2-one ✓ (2)

2.3.1 3,4-dibromo-2,2-dimethylpentane ✓ ✓ side chains ✓ numbering (3)



Remember if side chains are symmetrical - count from the 'busiest' side. The LHS has more side chains on carbon no 2.

2.3.2

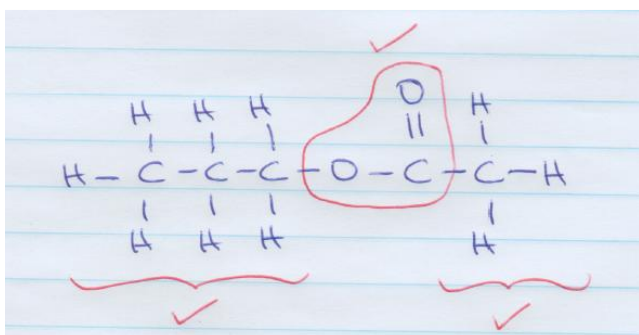


(1)

2.4 Esterification ✓

(1)

2.5.1

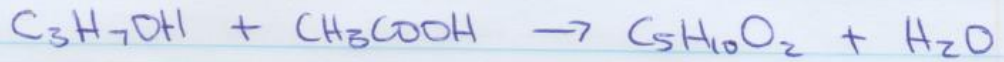


(3)

2.5.2 propyl ethanoate ✓

(2)

2.6



Given: $m = 55 \text{ g}$

$$n = \frac{m}{M}$$

$$= \frac{55}{60} \checkmark$$

$$= 0,9167 \text{ mol}$$

$$= 0,9167 \text{ mol}$$

$$m = 89,78 \text{ g}$$

(actual)

Produce:

$$n = 0,9167 \div 1 \times 1 \checkmark$$

$$= 0,9167$$

$$m = n \times M$$

$$= 0,9167 \times 102 \checkmark$$

$$= 93,5 \text{ g}$$

$$\% \text{ yield} = \frac{\text{actual } m}{\text{theor. } m} \times 100$$

$$= \frac{89,78}{93,5} \times 100 \checkmark$$

$$= 96,02\% \checkmark$$

(5)

[20]

Question 3 – organic properties

3.1.1 C/ ethanoic acid ✓ (1)

3.1.2 Ethanoic acid has hydrogen bonding at 2 sites ✓ which is the strongest intermolecular force compared to ethanal (dipole-dipole forces) and ethanol (hydrogen bonding at 1 site) ✓. This means it has the lowest volatility ✓ of the three and so will evaporate the slowest. (3)

3.2.1 No/Nee ✓



There is more than one independent variable. ✓
Daar is meer as een onafhanklike veranderlike.

OR/OF

Positions of functional groups and branching/chain length differ.
Posises van funksionele groepe en vertakking/kettinglengte verskil.

OR/OF

Compounds **A** and **B/C** are positional isomers and compounds **B** and **C** are chain isomers. (2)

- 3.2.2
- B/butan-2-ol is less branched / less compact / less spherical/ has a longer chain length / has a larger surface area (over which intermolecular forces act). ✓
 - B/butan-2-ol has stronger / more intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
 - More energy needed to overcome or break intermolecular forces / Van der Waals forces in B/butan-2-ol. ✓
 - B/butan-2-ol is minder vertak / minder kompak / minder sferies / het 'n langer kettinglengte / het 'n groter oppervlak (waaroor intermolekulêre kragte werk).
 - B/butan-2-ol het sterker / meer intermolekulêre kragte / Van der Waalskragte / London-kragte / dispersiekragte.
 - Meer energie benodig om intermolekulêre kragte / Van der Waalskragte/ dispersiekragte / London-kragte te oorkom in B/butan-2-ol.

OR/OF

- C/2-methylpropan-2-ol is more branched / more compact / more spherical / has a smaller surface area (over which intermolecular forces act). ✓
- C/2-methylpropan-2-ol has weaker / less intermolecular forces / Van der Waals forces / London forces / dispersion forces. ✓
- Less energy needed to overcome or break intermolecular forces / Van der Waals forces in C/2-methylpropan-2-ol. ✓

(3)

3.2.3 Compounds with the same molecular formula, but different positions of the side chain/substituents/functional groups on parent chain. ✓✓
Verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting/substituente/funksionele groepe op die stamketting. (2)

3.2.4 A and B ✓ (1)

3.2.5 101,3 (kPa) / 1,013 x 10⁵ Pa / 1 atm / 760 mmHg ✓ (1)

[13]

Question 4 – organic reactions

4.1.1 Elimination (Dehydration) ✓ (1)

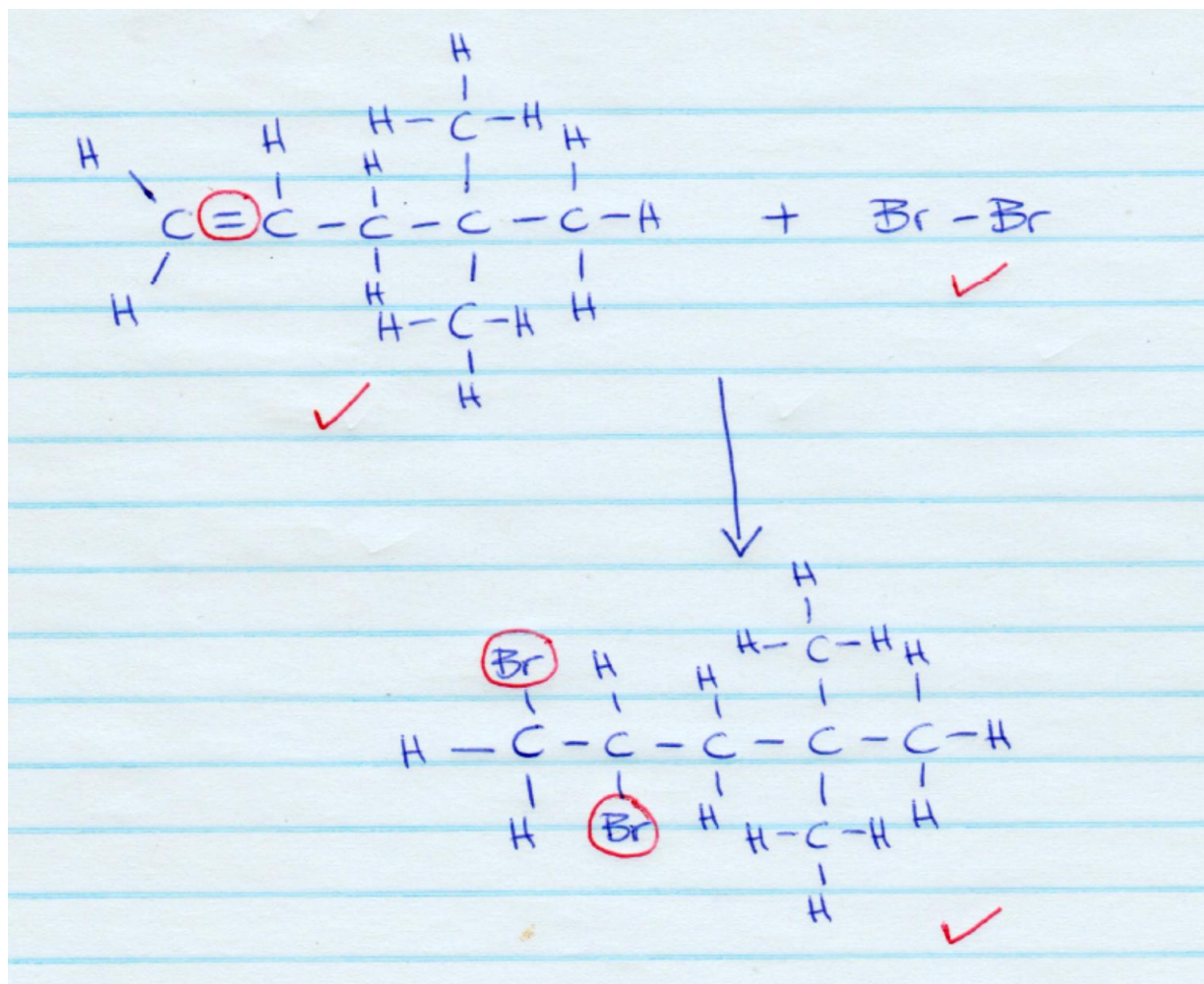
4.1.2 Water / H₂O ✓ (1)

4.1.3 Dehydrating agent/catalyst ✓ (1)

4.2 UNSATURATED ✓ Double bond between carbon atoms ✓ (2)

4.3 Addition (halogenation) ✓ (1)

4.4



(3)

[9]

Question 5

5.1 ONLY ANY ONE OF/SLEGS ENIGE EEN VAN:

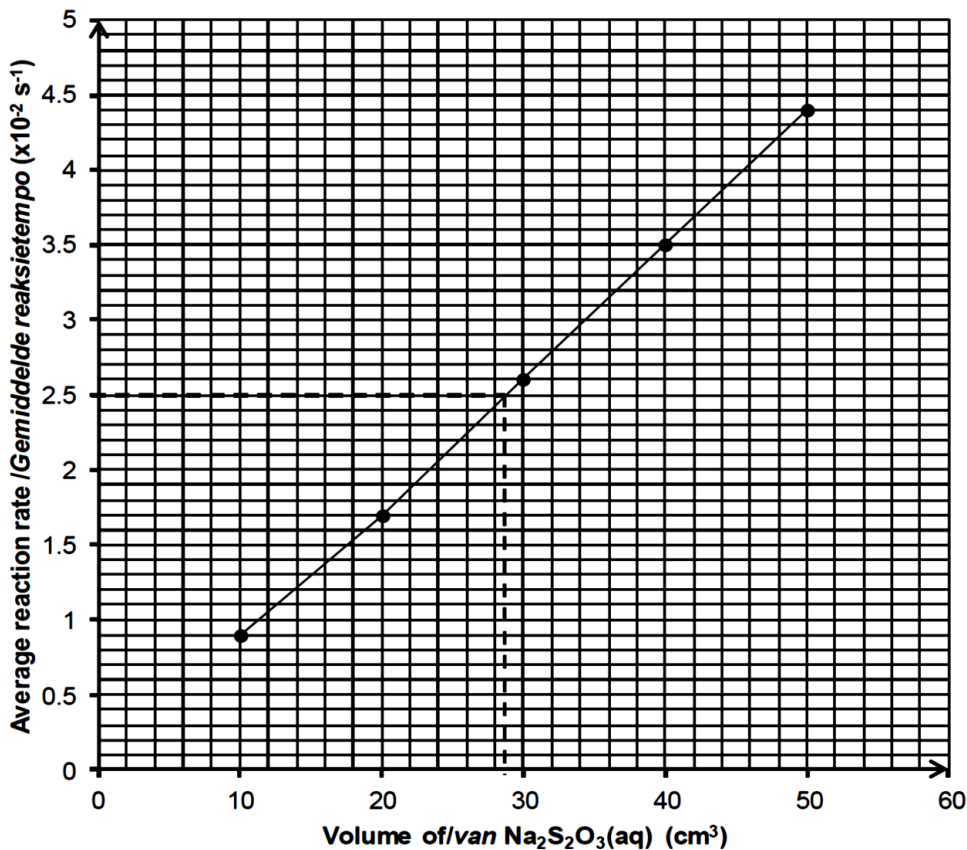
- Change in concentration of products/reactants ✓ per (unit) time. ✓
Verandering in konsentrasie van produkte/reaktanse per (eenheids)tyd.
- Rate of change in concentration. ✓✓
Tempo van verandering in konsentrasie.
- Change in amount/number of moles/volume/mass ✓ of products or reactants per (unit) time. ✓
Verandering in hoeveelheid/aantal mol/volume/massa van produkte of reaktanse per (eenheids)tyd.
- Amount/number of moles/volume/mass (of products) formed/(reactants) used ✓ per (unit) time. ✓
Hoeveelheid/aantal mol/volume/massa (van produkte) gevorm/(reaktanse) gebruik per (eenheids)tyd.

(2)

5.2 Greater than

(1)

5.3 **Graph of average reaction rate versus volume of $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$** **Grafiek van gemiddelde reaksietempo teenoor volume $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$**



Axes labelled correctly with units ✓

Points plotted accurately ✓

Straight line drawn ✓

(3)

5.4	Marking criteria/Nasienriglyne:
	y axis/y-as: $2,5 \times 10^{-2} \text{ s}^{-1}$ ✓
	Dotted line drawn from the y-axis to the x-axis as shown. ✓ Stippellyn getrek van y-as na x-as soos getoon.
	$V = 28 \text{ to } 30 \text{ cm}^3$ ✓

(3)

- 5.5
- More($\text{Na}_2\text{S}_2\text{O}_3$) particles per unit volume. ✓
Meer $\text{Na}_2\text{S}_2\text{O}_3$ -deeltjies per eenheid volume.
 - More effective collisions per unit time./Higher frequency of effective collisions. ✓
Meer effektiewe botsings per eenheid tyd./Hoër frekwensie van effektiewe botsings.
 - Increase in reaction rate./Toename in reaksietempo. ✓

(3)

5.6	<p>OPTION 1/OPSIE 1</p> $n(\text{S})_{\text{produced/gevorm}} = \frac{m}{M}$ $= \frac{1,62}{32} \checkmark$ $= 0,0506 \text{ mol}$ $n(\text{Na}_2\text{S}_2\text{O}_3) = n(\text{S}) = 0,0506 \text{ mol} \checkmark$ $n(\text{Na}_2\text{S}_2\text{O}_3) = \frac{m}{M}$ $0,0506 = \frac{m}{158} \checkmark$ $\therefore m(\text{Na}_2\text{S}_2\text{O}_3) = 7,99 \text{ g} \checkmark$ <p>[Range/Gebied: 7,90 to 8,06]</p>	<p>Marking criteria/Nasienriglyne:</p> <ul style="list-style-type: none"> • Substitute/Vervang 32 in $n = \frac{m}{M}$ ✓ • Use ratio/Gebruik verhouding: $\text{Na}_2\text{S}_2\text{O}_3$: S = 1 : 1 ✓ • Substitute/Vervang 158 in $n = \frac{m}{M}$ ✓ • Final answer/Finale antwoord: 7,90 to/tot 8,06 g ✓ <p>OPTION 2/OPSIE 2</p> $158 \text{ g} \checkmark \text{ Na}_2\text{S}_2\text{O}_3 \longrightarrow 32 \text{ g} \checkmark \text{ S}$ $\therefore x \longrightarrow 1,62 \text{ g S} \checkmark$ $x = \frac{158 \times 1,62}{32} = 7,99 \text{ g} \checkmark$ <p>[Range/Gebied: 7,90 to 8,06]</p>
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(4)

[16]

QUESTION 6/VRAAG 6

6.1 The stage in a chemical reaction when the rate of forward reaction equals the rate of reverse reaction. ✓✓ (2 or 0)

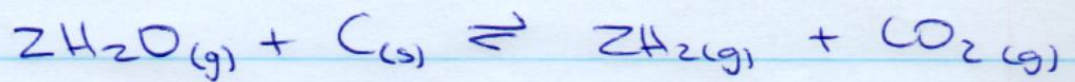
Die stadium in 'n chemiese reaksie waar die tempo van die voorwaartse reaksie gelyk is aan die tempo van die terugwaartse reaksie. (2 of 0)

OR/OF

The stage in a chemical reaction when the concentrations of reactants and products remain constant. (2 or 0)

Die stadium in 'n chemiese reaksie waar die konsentrasies van die reaktanse en produkte konstant bly. (2 of 0)

(2)



Initial mol	x	/	0	0
Change in mol	$-0,45$	/	$+0,45$	$+0,225$ ✓
Eqm mol	$x - 0,45$	/	0,45	0,225 ✓
Eqm C $= \frac{n}{V}$	$\frac{(x - 0,45)}{2}$	/	0,225	0,1125 ✓
$V = 2 \text{ dm}^3$				

$$K_c = \frac{[\text{H}_2]^2 [\text{CO}_2]}{[\text{H}_2\text{O}]^2} \checkmark$$

$$0,00948 = \frac{(0,225)^2 (0,1125)}{\left(\frac{x - 0,45}{2}\right)^2} \checkmark$$

$$\frac{x - 0,45}{2} = \sqrt{\frac{0,225^2 \cdot 0,1125}{0,00948}}$$

$$x = 2,00 \text{ mol}$$

$$\begin{aligned} m &= n \times M \\ &= 2,00 \times 18 \checkmark \\ &= 36 \text{ g} \checkmark \end{aligned}$$

(8)

6.3

6.3.1 Steam is used up./Amount of steam decreases./Concentration of steam decreases./Reactants are used up. ✓

Water word opgebruik./Hoeveelheid stoom neem af./Konsentrasie van stoom neem af./Reaktanse word opgebruik.

(1)

6.3.2 Catalyst was added./Katalisator is bygevoeg. ✓

(1)

6.3.3 Endothermic/Endotermies ✓

(1)

6.3.4 • The forward reaction is favoured./Die voorwaartse reaksie word bevoordeel. ✓

• Increase in temperature favours the endothermic reaction. ✓

Toename in temperatuur bevoordeel die endotermiese reaksie.

(2)

[15]

Question 7

7.1.1 H₂O ✓

HSO₄⁻ ✓

(2)

7.1.2 It is a very high K^a value meaning the equilibrium lies far to the right / sulfuric acid ionises completely ✓ and therefore is a STRONG acid. ✓

(2)

7.2

7.2.1

Marking Criteria/Nasienriglyne

• Formula/Formule: $\frac{c_a \times V_a}{c_a \times V_b} = \frac{n_a}{n_b} / c = \frac{n}{V}$ ✓

• Substitute/Vervang 0,15 x 24 **OR/OF** 0,15 x 0,024 ✓

• Use/Gebruik 26 cm³ **OR/OF** 0,026 dm³ ✓

• Use mole ratio/Gebruik molverhouding: 1:2 ✓

• Final answer/Finale antwoord: 0,28 mol·dm⁻³ ✓ (0.2769... mol·dm⁻³)

OPTION 1/OPSIE 1

$$\frac{c_a \times V_a}{c_a \times V_b} = \frac{n_a}{n_b} \quad \checkmark$$

$$\frac{0,15 \times 24}{c_b \times 26} = \frac{1}{2} \quad \checkmark$$

$$c(\text{NaOH}) = 0,28 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark$$

OPTION 2/OPSIE 2

$$\begin{aligned} n(\text{H}_2\text{SO}_4) &= cV \quad \checkmark \\ &= (0,15)(0,024) \quad \checkmark \\ &= 3,6 \times 10^{-3} \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{NaOH}) &= 2(3,6 \times 10^{-3}) \quad \checkmark \\ &= 7,2 \times 10^{-3} \text{ mol} \end{aligned}$$

$$\begin{aligned} c &= \frac{n}{V} \\ &= \frac{7,2 \times 10^{-3}}{0,026} \quad \checkmark \\ &= 0,28 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \end{aligned}$$

(5)

7.2.2

Marking Criteria/Nasienriglyne

- Calculate/Bereken $n(\text{NaOH})$: $0,02 \times 0,28$ ✓
- Calculate/Bereken $n(\text{H}_2\text{SO}_4)$: $0,03 \times 0,15$ ✓
- Use ratios/Gebruik molverhouding: $n(\text{H}_2\text{SO}_4) = \frac{1}{2}n(\text{NaOH})$ ✓
- $n(\text{H}_2\text{SO}_4)_{\text{excess}} = n(\text{H}_2\text{SO}_4)_{\text{initial}} - n(\text{H}_2\text{SO}_4)_{\text{used}} = 0,0045 - 0,0028$ ✓
- Substitute/Vervang $0,05 \text{ dm}^3$ in $c = \frac{n}{V}$ ✓
- Substitution/Vervang $2 \times 0,034$ in $2[\text{H}_2\text{SO}_4]$ ✓
- Formula/Formule: $-\log[\text{H}_3\text{O}^+]$ **OR/OF** Substitute/Vervang: $-\log(0,068)$ ✓
- Final answer: 1,10 to/tot 1,167 ✓

OPTION 1/OPTION 1

$$\begin{aligned}
 n(\text{NaOH}) &= cV \\
 &= 0,02 \times 0,28 \checkmark \\
 &= 0,0056 \text{ mol} \\
 n(\text{H}_2\text{SO}_4) &= 0,03 \times 0,15 \checkmark \\
 &= 0,0045 \text{ mol} \\
 n(\text{H}_2\text{SO}_4)_{\text{used}} &= \frac{1}{2}n(\text{NaOH}) \checkmark \\
 &= 0,0028 \\
 n(\text{H}_2\text{SO}_4)_{\text{excess}} &= 0,0045 - 0,0028 \checkmark \\
 &= 0,0017 \text{ mol} \\
 [\text{H}_2\text{SO}_4] &= \frac{n}{V} = \frac{0,0017}{0,05} \checkmark \\
 &= 0,034 \text{ mol} \cdot \text{dm}^{-3} \\
 [\text{H}_3\text{O}^+] &= 2[\text{H}_2\text{SO}_4] \checkmark \\
 &= 2 \times 0,034 \checkmark \\
 &= 0,068 \text{ mol} \cdot \text{dm}^{-3} \\
 \text{pH} &= -\log[\text{H}_3\text{O}^+] \text{ **OR/OF** } -\log(0,068) \checkmark \\
 &= 1,17 \checkmark \quad (1,167)
 \end{aligned}$$

OPTION 2/OPTION 2

$$\begin{aligned}
 n(\text{NaOH}) &= cV \\
 &= 0,02 \times 0,28 \checkmark \\
 &= 0,0056 \text{ mol} \\
 n(\text{H}_2\text{SO}_4) &= 0,03 \times 0,15 \checkmark \\
 &= 0,0045 \text{ mol} \\
 n(\text{H}_3\text{O}^+) &= 2n(\text{H}_2\text{SO}_4) \checkmark \\
 &= 2 \times 0,0045 \\
 &= 0,009 \text{ mol} \\
 n(\text{H}_3\text{O}^+)_{\text{excess}} &= 0,009 - 0,0045 \checkmark \\
 &= 0,0034 \text{ mol} \\
 c(\text{H}_3\text{O}^+) &= \frac{n}{V} \\
 &= \frac{0,0034}{0,05} \checkmark \\
 &= 0,068 \text{ mol} \cdot \text{dm}^{-3} \\
 \text{pH} &= -\log[\text{H}_3\text{O}^+] \text{ **OR/OF** } -\log(0,068) \checkmark \\
 &= 1,17 \checkmark \quad (1,167)
 \end{aligned}$$